

Weather Note

A PINWHEEL CLOUD FORMATION AS VIEWED BY TIROS I

R. W. WHITE

U.S. Weather Bureau, Washington, D.C.

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An interesting cloud configuration was photographed by the TIROS I weather satellite on May 23, 1960 at 1955 GMT, 60 n. mi. west-southwest of Huron, S. Dak. In figure 1, the TIROS picture of the pinwheel cloud formation, State boundaries, and selected station locations have been superimposed for convenient reference, with an estimated picture element location accuracy of ± 20 n. mi. At the time figure 1 was recorded, the satellite was located over central Minnesota at a height of 395 n. mi. and the wide-angle camera was viewing the area to the west and south of the satellite's position. The nucleus of the pinwheel cloud is some 40 n. mi. in diameter, with the outwardly extending spiral filaments increasing its diameter to approximately 90 n. mi. These spiral filaments suggested a mesoscale cyclonic vortex, hence analysis was undertaken to identify the system.

Daily temperature and precipitation observations, from cooperative Weather Bureau stations in South Dakota, were extracted from the *Climatological Data* for May 1960. Radar data from Weather Bureau, Air Weather Service, and Air Defense Command stations surrounding the pinwheel formation were analyzed. To supplement the transmitted teletypewriter data, accelerated microbarograph traces, triple register, and surface observational forms from surrounding stations were examined. Upper-air and wind analyses were constructed through the 300-mb. level in an attempt to determine if a horizontal or vertical shear, thermal, or pressure pattern was responsible for the motion or configuration of the pinwheel cloud pattern. A 10,000-ft. streamline analysis for 1800 GMT is superimposed on plotted surface observations for 2000 GMT in figure 2.

Insofar as possible, a mesoanalysis was performed on all available data. Examination of accelerated microbarograph traces and triple registers did not reveal any pressure perturbations or other characteristics such as those discussed by Fujita et al. [1] as normally being associated with a mesoscale circulation.

The schematic depiction in figure 2 is the result of a careful picture rectification and examination of all available data, which showed the formation to be composed of:

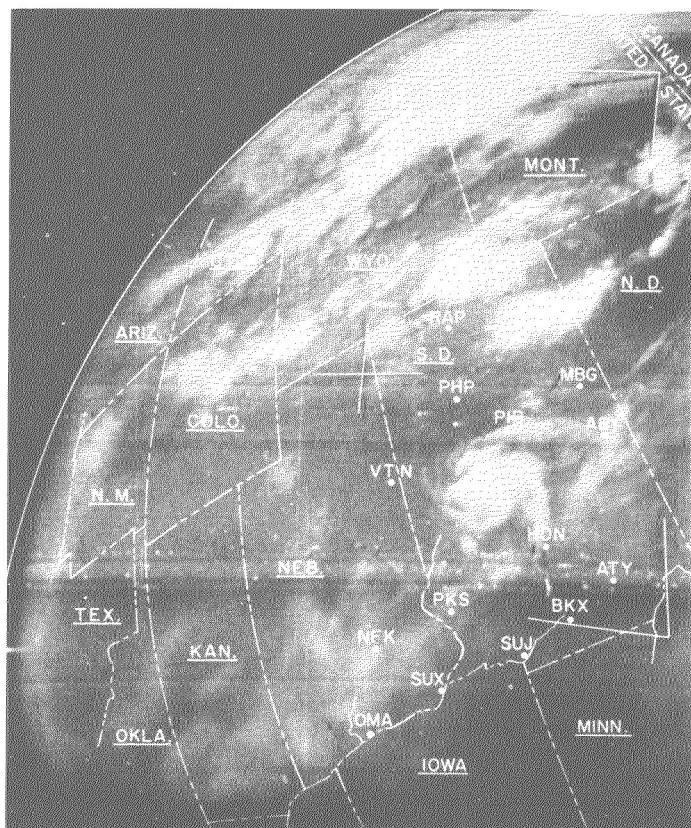


FIGURE 1.—TIROS I picture of the pinwheel cloud formation with superimposed grid of State boundaries and selected station locations. 1955 GMT, May 23, 1960.

	Bases (ft.)	Tops (ft.)
Cumulus and stratocumulus.....	3, 200-3, 600	5, 000-7, 000
Alto cumulus castellatus.....	8, 000	12, 000-14, 000
Cirriform.....	26, 000	34, 000

All analysis failed to support any hint of a mesoscale pressure system, nor did the cloud formation have any apparent relationship to pressure, thermal, or wind patterns at the surface or in the lower atmosphere. Analyses

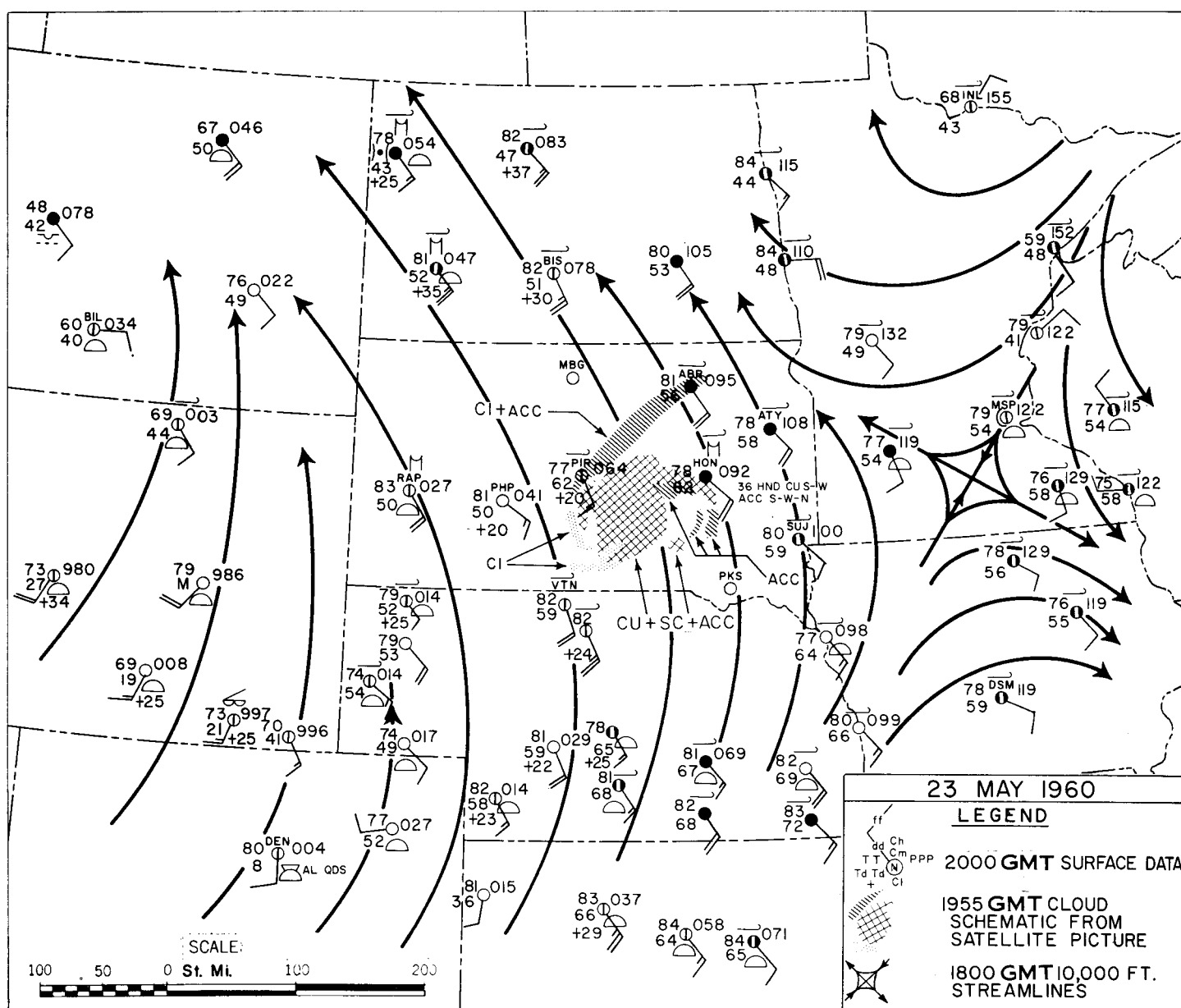


FIGURE 2.—2000 GMT surface observations concurrent with picture time of figure 1, with superimposed 1800 GMT 10,000-ft. streamline analysis and schematic depiction of pinwheel cloud formation.

of radar and precipitation observations could not be associated with the pinwheel configuration.

The mesoscale cyclonic circulation, which was so vividly suggested by the spiral cloud filaments surrounding the pinwheel pattern, could not be confirmed by analyses of all observational data. It would therefore appear that this cloud configuration reveals motion much more complex than a simple swirl of clouds in a horizontal plane. For example, it might have been a result of three-dimensional trajectories that were not possible to delineate with the collected observational data. This study emphasizes that meteorologists should exercise caution in interpreting satellite cloud pictures because the pictures are two-dimensional while the atmosphere is a three-

dimensional fluid, and a proper interpretation must always consider this third dimension.

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REFERENCE

1. T. Fujita, H. Newstein, and M. Tepper, "Mesoanalysis, An Important Scale in the Analysis of Weather Data," *Research Paper No. 39*, U.S. Weather Bureau, Washington, D.C., Jan. 1956, 83 pp.